Back Bay NWR Neotropical/Landbird Survey
Conducted 1994-1998

Summarized by Andrew Campomizzi and Christopher Wicker

I. Introduction

The neotropical/landbird survey was performed to collect baseline data for both migratory and resident birds on the refuge. The data are useful for monitoring species presence, species habitat association, and population trends over the years. An important goal of the survey is to identify species of concern and to associate these species with habitat preference for future conservation and management purposes. Species of management concern are those that have shown significant population declines in the North American Breeding Bird Survey since 1966, or have been listed as threatened, endangered, or a species of concern by the state of Virginia or the US Fish and Wildlife Service (Table 1).

II. Data Collection

Point count is an area of 100 meters radius with a 8-foot stake numbered by a metal pinned on top as its center, following guidelines established by the North American Breeding Bird Survey and were monitored in a 5-year period, from 1994 to 1998 (Sauer et al. 1997). All birds identified by sight and sound within a 100-meter radius of each point were recorded in a 5-minute period. Each year, point counts were surveyed once within a 11-day period in late April and early May during spring migration and again in mid-June during the breeding season. Sixty-one points were established throughout dune grass, shrub scrub, emergent marsh, and wooded habitats. In 1999, vegetation within 100-meter radius at each point was analyzed in order to classify points by habitat type on the refuge (Hamel et al. 1996).

III. Results

In spring, surveys accounted 25 species of concern and 16 during summer (Table 1). Spring surveys documented the presence of 159 species on the refuge, including 124 neotropical migrants and 88 landbird species. During summer surveys, 110 avian species were identified, including 80 neotropical migrants and 61 landbird species (Table 2). Overall, 68 species were identified in wooded habitats, 64 in emergent marsh, 63 in shrub scrub, and 52 in dune grass.

Wooded habitats on the refuge supported the highest average diversity of landbird species and lowest average relative abundance compared to other habitat types in both spring (figure 1 and 3) and summer (figure 2 and 4) seasons. The highest average relative abundance and lowest number of species were found in dune grass habitat during both spring and summer surveys. Because dune habitat held the highest average relative abundance in both seasons, figure 3 and 4 shows the subsequent

increases in its occupation during summer of 1996-1998 (figure 3) and 1995 -1998 (figure 4), while other habitat uses fluctuate. According to the data observed by expert volunteers, between springs of 1995 and 1996, there was a substantial increase in the number of Common Grackle (1-49), Boat-tailed Grackle (57-75), American Crow (1-10), and Yellow-breasted Chat (0-8). The following summer, Purple Martin (6-34), American Goldfinch (0-15), and Field Sparrow (5-14) also showed substantial increases. Finally, between the summers of 1997 and 1998, the number of Boat-tailed Grackles decreased (85-36) while European Starling numbers increased sharply from 3 to 140. All of these data were recorded in dune habitat.

Frequency of occurrence data of other species of concern observed on this refuge are shown in table 3 for spring and table 4 for summer. These tables show whether or not and how much they frequent each of the four habitats: dune, scrub shrub, emergent wetland, and wooded. Relative abundance data of these species of concern are displayed in table 5 for spring and table 6 for summer. Unlike frequency of occurrence tables, tables 5 and 6 show their relative abundance in each year from 1994 to 1998, regardless of which habitat they were in. Their numbers may show fluctuations, stabilization, or absent in some years and present in other years. Three species of concern (Barn Swallows, Eastern Kingbirds, and Common Yellowthroats) were chosen to exemplify using these tables.

Barn swallows were observed to be a large number of neotropical birds existing on the refuge every spring season. During the 5-year survey in spring, they ranged from 76 to 594 in total, however their numbers have decreased in summer, from 4 to 22. According to frequency of occurrence calculations, they utilized dune (84.73%) and scrub shrub (62.02%) habitats more than emergent marsh (26.17%) and wooded (11.77%) areas during spring. They rarely stay on this refuge during the summer, as their numbers dwindled according to survey data over five years. Barn swallow is one of species of concern visiting this refuge during migration.

Eastern Kingbirds are also neotropical migrants and labeled as species of concern on this refuge. According to spring survey data, their numbers ranged from 10 to 18 in total, while they decreased but maintained their numbers, ranging from 5 to 13 in summer. They occupied dune (27.53%), scrub shrub (15.96%), and emergent marsh (17.29%) habitats, and few were observed in wooded (1.33%) area during spring surveys. Except for emergent marsh (23.25%) habitat, their occupation of other habitats decreased in summer: dune (6.67%), scrub shrub (10.74%), and wooded (0%). Their frequency of occurrence increases in emergent marsh habitat during the summer survey, indicating their preference for small scattered trees in an opened area. This may apply to scrub shrub, a similar habitat to emergent marsh.

Common Yellowthroats are the most common neotropical birds utilizing this refuge from their migration during spring and summer seasons. In spring survey, they ranged from 47 to 66 in total, while they maintained their good number of population from 25 to 42 during summer survey. They existed in all four main habitats during spring: dune

(60.87%), scrub shrub (59.63%), emergent marsh (56.90%), and wooded (38.10%). During summer, they maintain similar numbers in these habitats, although frequency of occurrence decreased in dune habitat (46.22%). Common Yellowthroat is also one of species of concern.

The number of avian species of concern in each of the four habitats during the 5-year period is shown in figure 1 for spring and figure 2 for summer. Figure 3 displays their relative abundance in each of the four habitats during the 5-year period in spring and figure 4 in summer. This also applies to frequency of occurrence data in figure 5 for spring and figure 6 for summer. These figures do not indicate which species but the number of species occupying a habitat during a year observed.

Relative abundance of all the landbird species observed on this refuge during spring of each year is tabulated in table 7 and summer in table 8. These tables include a list of landbird species observed in each season. They can be used for comparing seasons of the same year or seasons of the different years. Habitat types are not included in these tables. Table 7 contains a longer list of landbird species than table 8 because most of them were observed in spring. Relative abundance is obtained by dividing a number of bird per species from a number of point counts (48) which were surveyed consistently over the 5-year period. For example, relative abundance of Barn Swallows increased sharply from 1994 (1.58) to 1995 (12.38), decreased in 1996 (2.13), and then stabilized in the last two years of spring survey period: 1997 (4.35) and 1998 (4.52). Their population decreased the following summer of each year: 1994 (0.46), 1995 (0.08), 1996 (0.17), 1997 (0.42), and 1998 (0.25). According to these data, Barn Swallows are active in breeding or feeding on this refuge during spring. They may have declined the following summer due to their migration. Other birds, such as Common Yellowthroats and Eastern Kingbirds, seem to be stabilizing throughout the 5-year period of both seasons, although a small fluctuation exists between spring and summer.

Habitat preference for species of concern during the summer is evident by their average frequency of occurrence in a given habitat type (Table 4). Higher frequency of occurrence in a habitat type suggests possible nesting activity. During spring migration, however, species make use of additional food and cover by using more habitats than in the summer (Table 3). Tables 5 and 6 indicate the relative abundance for species of management concern on the refuge during both survey seasons. Data used for the relative abundance calculations are from points surveyed 5 consecutive years, 1994-1998. 48 points were surveyed for 5 consecutive years during the spring and 17 points in the summer. Spring surveys show an increase in the relative abundance of Great Crested Flycatchers on the refuge (Table 7). European Starlings also showed an increase in relative abundance in the summer of 1998 compared to previous years (Table 8).

IV. Discussion/Management Implications

The survey indicates the refuge provides habitat during spring migration as well as the breeding season to a number of landbird species. All habitat types need to be conserved and managed because species are not evenly distributed or even found in all habitats. None of the four habitat types support all landbird species. Even though the greatest species diversity was observed in wooded habitats, not all species were observed. For example, Yellow Warblers and Eastern Kingbirds were not observed at the points in wooded habitat but were found in other habitats on the refuge.

High relative abundance found in dune habitat may be misleading. Because dune and shrub scrub habitats along the eastern portion of the refuge are in such close proximity, birds observed at points in the dunes may or may not be using both habitats at a time. However, both of these habitats are important to landbird species shown by the number of species and abundance found during both seasons. Points within dune area supported an increasing number of species and a higher relative abundance from 1995-1998 in summer season (Figure 4). The influx of Grackle species and European Starlings could be attributed to an improvement in the habitat such as food, cover, or available nesting habitat. However, the increased presence of these species did not appear to deter other species from dune habitat.

Unlike the North American Breeding Bird Survey and many other neotropical bird population studies, this survey did not indicate any conclusive population declines (DeGraaf, Rappole). Overall, the survey did not indicate declines in relative abundance for any species on the refuge (Table 6, Table 7). They seemed to be fluctuating year by year.

Problems were encountered analyzing the survey data. The biggest problem was created by the shortage of volunteers needed to survey all of the points. Therefore, not all points were surveyed consistently. This made the analysis and interpretation of the data difficult. Effort has been made to exclude the inconsistencies in order to produce purposeful results. For example, 48 out of 61 points have been chosen for this report because they were observed throughout spring season in a five-year period. This also applied to summer season, which has 17 out of 61 points observed consistently for five years. However, summer season data may be inconclusive due to small number of points observed. This means that not all habitats have enough points counted to verify the number or presence of neotropical or land birds. For example, according to the 1996 summer season data, only four out of eleven points in wooded habitat were observed, which indicates a lower number of birds identified. When I divided a number of species by a small number of points observed, the result showed a large number of birds using the habitat during survey period, which is not true since expert volunteers were unable to observe other points in the same habitat. It is critical to have all the points in each habitat observed during the survey period to acquire all the data needed to make this report accurate and conclusive.

Literature Cited

DeGraaf, R.M., and J. H. Rappole. 1995. Neotropical Migratory Birds: Natural History, Distribution, and Population Change. Cornell University Press.

Hamel, P. B., W. B. Smith, D. J. Twedt, J. R. Woehr, E. Morris, R. B. Hamilton, and R. J. Cooper. 1996. A Land Manager's Guide to Point Counts of Birds in the Southeast. General Technical Report SO-120. USDA Forest Service, Southern Research Station. PO box 2680, Asheville NC 28802. 39 pp.

Sauer, J. R., J. E. Hines, G. Gough, I. Thomas, and B. G. Peterjohn. 1997. The North American Breeding Bird Survey Results and Analysis. Version 96.4. Patuxent Wildlife Research Center, Laurel, MD

Bird Species	Federal	State	USGS BBS 1966-1998 US FWS R5	USGS BBS 1966-1987 Mid-Atlantic	USGS BBS 1966-1998 VA
Caspian Tern #		SC			
Brown Pelican # *		SC			
Glossy Ibis # *		SC			
Great Egret # *		SC			
Little Blue Heron # *		SC			
Tricolored Heron # *		SC			
Bald Eagle # *	LT	LT			
Northern Harrier #		SC			
Yellow-billed Cuckoo # *			-	-	-
Chimney Swift # *			-	-	-
Barn Swallow *			-		-
Sedge Wren #		SC			
Eastern Kingbird # *			-		-
Great Crested Flycatcher # *			-		
Eastern Wood Pewee # *			-	-	-
Gray Catbird # *				-	-
Wood Thrush # *			-	-	-
White-eyed Vireo # *				-	
Yellow Warbler # *					-
Black-throated Green Warbler #				-	
Black-and-white Warbler #			-	-	
Prairie Warbler # *				-	
Prothonotary Warbler # *				-	
Yellow-throated Warbler #				-	
Swainson's Warbler #		SC			
Common Yellowthroat # *				-	
Yellow-breasted Chat # *			-		
Indigo Bunting # *			-	-	
Rose-breasted Grosbeak #					-
Chipping Sparrow #			-		
Scarlet Tanager #			-	-	
Baltimore Oriole #			-		
Orchard Oriole # *				-	

Table 1: Species of concern observed at Back Bay National Wildlife Refuge during a 5-year surveys period. LT = List Threatened; SC = Special Concern; - = statistically significant declines reported in BBS; # = observed in spring; and * = observed in summer.

Horned Grebe *	Sanderling *	Blackpoll Warbler * +
Pied-billed Grebe * #	Dunlin *	Myrtle Warbler * +
Common Loon *	Rock Dove * # +	Pine Warbler * # +
Bonaparte's Gull *	Mourning Dove * # +	Prairie Warbler * # +
Great Black-backed Gull * #	Turkey Vulture * #	Hooded Warbler * +
Laughing Gull * #	Osprey * #	Prothonotary Warbler * # +
Ring-billed Gull * #	Bald Eagle * #	Black-and-white Warbler * +
Herring Gull *	Northern Harrier *	Yellow-throated Warbler * +
Caspian Tern *	Merlin *	Blue-winged Warbler * +
Royal Tern * #	American Kestrel *	Ovenbird * # +
Forsters Tern * #	Red-shouldered Hawk *	Swainson's Warbler * +
Sandwich Tern #	Red-tailed Hawk *	Yellow-breasted Chat * # +
Least Tern #	Sharp-shinned Hawk *	Common Yellowthroat * # +
Common Tern * #	Great-horned Owl * #	American Redstart * # +
Gull-billed Tern *	Barred Owl #	Northern Waterthrush * +
Black Skimmer #	Yellow-billed Cuckoo * # +	Louisiana Waterthrush * +
Northern Gannet *	Red-bellied Woodpecker * # +	Eastern Towhee * # +
Double-Crested Cormorant * #	Red-headed Woodpecker * # +	Northern Cardinal * # +
Brown Pelican * #	Yellow-shafted Flicker * # +	Indigo Bunting * # +
Red-breasted Merganser * #	Downy Woodpecker * # +	Blue Grosbeak * # +
Mallard * #	Hairy Woodpecker * +	Rose-breasted Grosbeak * +
American Black Duck * #	Pileated Woodpecker * # +	House Finch * # +
American Wigeon * #	Belted Kingfisher # +	American Goldfinch * # +
Gadwall * #	Chimney Swift * # +	Chipping Sparrow * +
Northern Shoveler *	Purple Martin * # +	Field Sparrow * # +
Blue-winged Teal *	Tree Swallow * # +	Song Sparrow * # +
Wood Duck * #	N. Rough-winged Swallow * +	Swamp Sparrow * +
Northern Pintail #	Barn Swallow # +	Savannah Sparrow * +
Canada Goose * #	Cliff Swallow * +	White-throated Sparrow * +
Tundra Swan *	Ruby-throated Hummingbird # +	Sparrow sp. * +
Mute Swan * #	Carolina Wren * # +	Scarlet Tanager * +
Glossy Ibis * #	Sedge Wren * +	Summer Tanager * # +
Least Bittern * #	Marsh Wren * # +	Bobolink * +
Yellow-crowned Night-heron *	White-breasted Nuthatch * # +	Brown-headed cowbird * # +
Great Blue Heron * #	Brown-headed Nuthatch * +	Red-winged Blackbird * # +
Great Egret * #	Eastern Tufted Titmouse * # +	Eastern Meadowlark * # +
Snowy Egret * #	Carolina Chickadee * # +	Baltimore Oriole * +
Cattle Egret * #	Ruby-crowned Kinglet * +	Orchard Oriole * # +
Little Blue Heron * #	Blue-gray Gnatcatcher * # +	Boat-tailed Grackle * # +
Tricolored Heron * #	Eastern Kingbird * # +	Common Grackle * # +
Green Heron * #	Acadian Flycatcher * # +	Great-tailed Grackle # +
King Rail * #	Great Crested Flycatcher * # +	European Starling * # +
Clapper Rail * #	Eastern Wood Pewee * # +	
Virginia Rail * #	Northern Mockingbird * # +	
Sora *	Gray Catbird * # +	
American Coot * #	Brown Thrasher * # +	
Northern Bobwhite * #	Water Pipit * +	
Common Snipe *	American Robin * +	
Short-billed Dowitcher *	Eastern Bluebird * # +	
Dowitcher Sp. * #	Wood Thrush * # +	
Semipalmated Sandpiper *	Blue Jay * # +	
Least Sandpiper *	American Crow * # +	
Spotted Sandpiper * #	Fish Crow * # +	
Solitary Sandpiper *	Cedar Waxwing * # +	
Greater Yellowlegs * #	White-eyed Vireo * # +	
Lesser Yellowlegs * #	Red-eyed Vireo * # +	
Willet *	Philadelphia Vireo * +	
Whimbrel *	Northern Parula * +	
Semipalmated Plover * #	Yellow Warbler * # +	
Killdeer * #	Black-throated Blue Warbler * +	
Black-necked Stilt *	Black-throated Green Warbler * +	
American Avocet *	Blackburnian Warbler * +	

Table 2: These avian species were observed on the refuge during the 5-year surveys period. * = observed in spring surveys; # = observed in summer surveys; + = landbird species; and = non-neotropical migrant (Degraaf and Rappole).

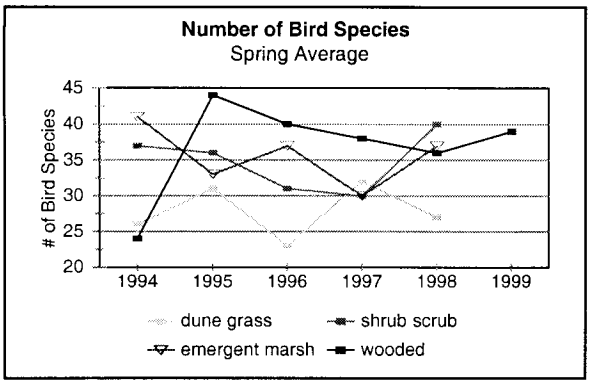

Figure 1: An average number of landbird species were observed in each habitat during a 5-year spring surveys period.

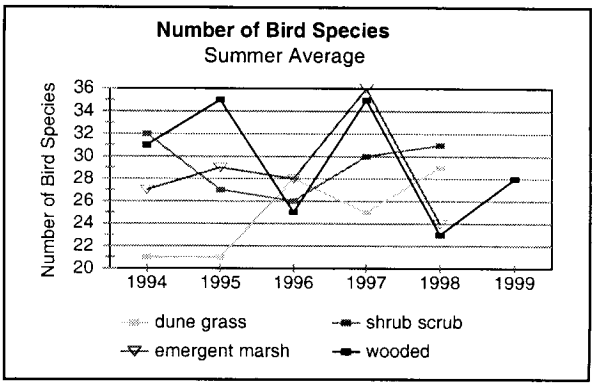

Figure 2: An average number of landbird species were observed in each habitat during a 5-year summer surveys period.

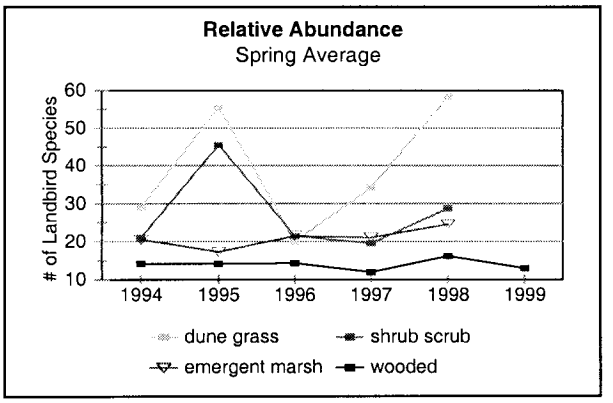

Figure 3: An average relative abundance of landbird species were observed in each habitat during a 5-year spring surveys period.

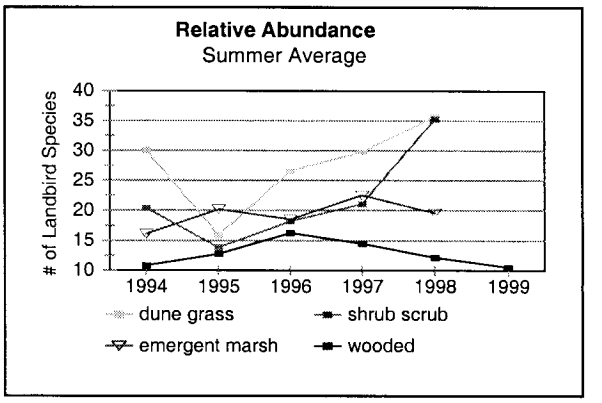

Figure 4: An average relative abundance of landbird species were observed in each habitat during a 5-year summer surveys period.

Bird Species	1994	1995	1996	1997	1998
Yellow-billed Cuckoo	0.02	0.04	-	-	0.04
Chimney Swift	0.60	0.17	0.10	0.13	0.46
Barn Swallow	1.58	12.38	2.13	4.35	4.52
Sedge Wren	-	-	0.02	0.06	-
Eastern Kingbird	0.29	0.21	0.29	0.38	0.29
Great Crested Flycatcher	0.19	0.10	0.25	0.25	0.31
Eastern Wood Pewee	-	0.02	0.04	-	0.08
Gray Catbird	0.54	0.71	0.15	0.25	0.25
Wood Thrush	0.02	0.13	0.06	-	0.04
White-eyed Vireo	0.10	0.15	0.13	0.08	0.23
Yellow Warbler	0.06	0.27	0.02	-	0.02
Black-throated green Warbler	-	0.02	-	-	-
Prairie Warbler	0.31	0.19	0.25	0.35	0.25
Prothonotary Warbler	0.17	0.08	0.04	0.06	0.04
Yellow-throated Warbler	-	0.04	-	-	-
Black-and-white Warbler	-	0.04	-	-	-
Yellow-breasted Chat	0.19	0.25	0.06	0.17	0.13
Common Yellowthroat	1.38	1.13	1.38	0.98	1.04
Indigo Bunting	-	0.02	0.02	-	0.08
Chipping Sparrow	-	-	-	-	0.02
Scarlet Tanager	-	0.04	-	-	0.02
Baltimore Oriole	-	-	-	0.04	0.04
Orchard Oriole	0.04	0.02	0.19	0.13	0.06

Table 3: An average relative abundance of species of concern were observed on the refuge, regardless of habitats, during a 5-year spring surveys period.

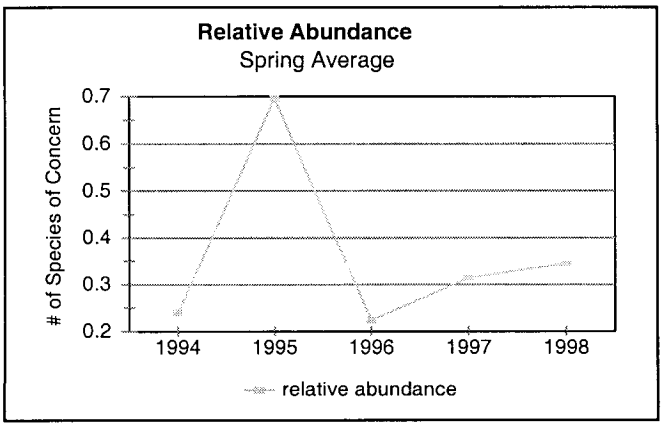

Figure 5: Relative abundance of observed species of concern varies during a 5-year spring surveys period.

Bird Species	1994	1995	1996	1997	1998
Yellow-billed Cuckoo	0.06	0.10	0.17	0.17	0.25
Chimney Swift	-	0.02	0.04	-	-
Barn Swallow	0.46	0.08	0.17	0.42	0.25
Eastern Kingbird	0.13	0.10	0.27	0.19	0.19
Eastern Wood Pewee	0.04	0.08	-	0.19	0.06
Gray Catbird	0.25	0.17	0.15	0.21	0.15
White-eyed Vireo	0.04	0.04	0.06	0.08	0.08
Prairie Warbler	-	0.08	0.02	0.17	0.06
Yellow-breasted Chat	0.27	0.19	0.31	0.46	0.38
Common Yellowthroat	0.52	0.79	0.85	0.88	0.63
Indigo Bunting	0.25	0.29	0.42	0.15	0.35
Orchard Oriole	0.06	0.02	0.02	0.17	0.08

Table 4: An average relative abundance of species of concern were observed on the refuge, regardless of habitats, during a 5-year summer surveys period.

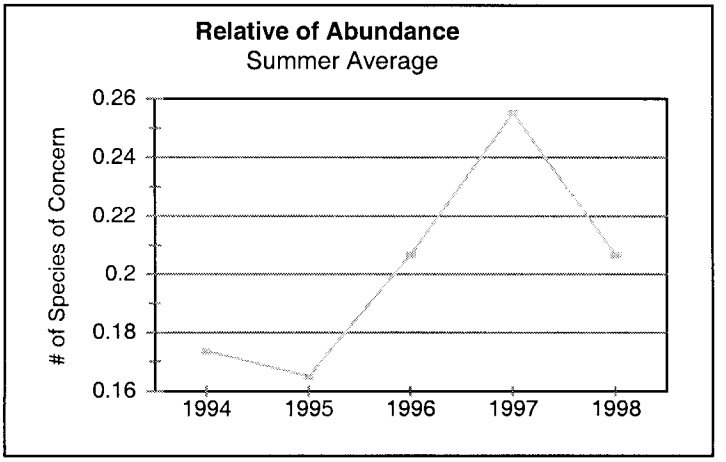

Figure 6: Relative abundance of observed species of concern varies during a 5-year summer surveys period.

Bird Species	Dune	Shrub	Marsh	Wooded
Yellow-billed Cuckoo	-	1.43%	-	5.93%
Chimney Swift	33.62%	10.79%	5.81%	4.41%
Barn Swallow	84.73%	62.02%	26.17%	11.77%
Sedge Wren	-	-	2.86%	-
Eastern Kingbird	27.53%	15.96%	17.29%	1.33%
Great Crested Flycatcher	5.02%	2.58%	9.03%	45.51%
Eastern Wood Pewee	-	-	-	5.63%
Gray Catbird	40.87%	38.48%	7.13%	24.09%
Wood Thrush	2.22%	-	-	13.96%
White-eyed Vireo	15.56%	14.51%	8.13%	5.84%
Yellow Warbler	21.93%	5.33%	2.06%	1.43%
Black-throated Green Warbler	2.22%	-	-	-
Black-and-white Warbler	2.20%	1.33%	-	-
Prairie Warbler	31.40%	35.32%	11.59%	14.93%
Prothonotary Warbler	6.67%	1.25%	2.00%	16.11%
Yellow-throated Warbler	-	1.40%	-	-
Swainson's Warbler	-	-	-	1.40%
Common Yellowthroat	60.87%	59.63%	56.90%	38.10%
Yellow-breasted Chat	26.38%	25.57%	2.06%	4.21%
Indigo Bunting	6.67%	3.92%	-	-
Rose-breasted Grosbeak	-	-	-	1.43%
Chipping Sparrow	-	1.33%	-	-
Scarlet Tanager	-	-	1.20%	2.86%
Baltimore Oriole	2.20%	2.60%	-	-
Orchard Oriole	-	5.32%	12.75%	1.33%

Table 5: An average frequency of occurrence of each species of concern was observed in each habitat on the refuge during a 5-year spring surveys period, regardless of which year.

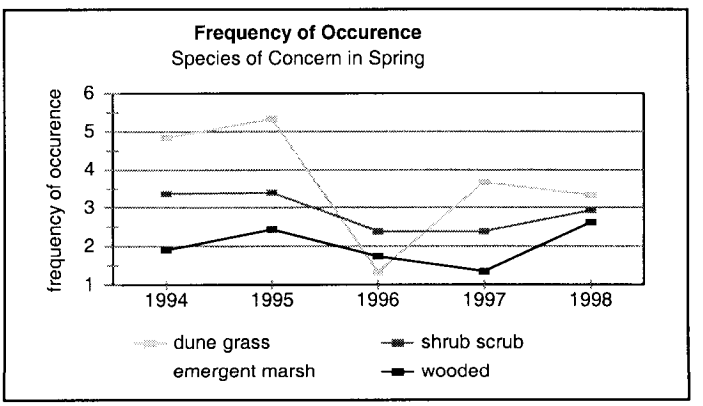

Figure 7: Frequency of occurrence of observed species of concern varies in each habitat during a 5-year spring surveys period.

Bird Species	Dune	Shrub	Marsh	Wooded
Yellow-billed Cuckoo	6.67%	16.17%	10.61%	22.40%
Chimney Swift	2.22%	1.54%	-	-
Barn Swallow	34.16%	17.62%	10.98%	-
Eastern Kingbird	6.67%	10.74%	23.25%	-
Great Crested Flycatcher	4.00%	2.87%	-	31.25%
Eastern Wood Pewee	-	-	3.93%	18.43%
Gray Catbird	30.22%	16.86%	4.00%	5.15%
Wood Thrush	-	-	0.95%	19.27%
White-eyed Vireo	6.67%	5.29%	1.18%	11.41%
Yellow Warbler	2.22%	1.54%	-	-
Prairie Warbler	6.67%	7.12%	3.08%	4.90%
Prothonotary Warbler	-	-	-	13.41%
Common Yellowthroat	46.22%	54.83%	59.16%	33.72%
Yellow-breasted Chat	56.44%	36.60%	14.44%	8.41%
Indigo Bunting	15.56%	29.89%	27.54%	9.36%
Orchard Oriole	2.20%	6.62%	8.66%	1.54%

Table 6: An average frequency of occurrence of each species of concern was observed in each habitat on the refuge during a 5-year summer surveys period, regardless of which year.

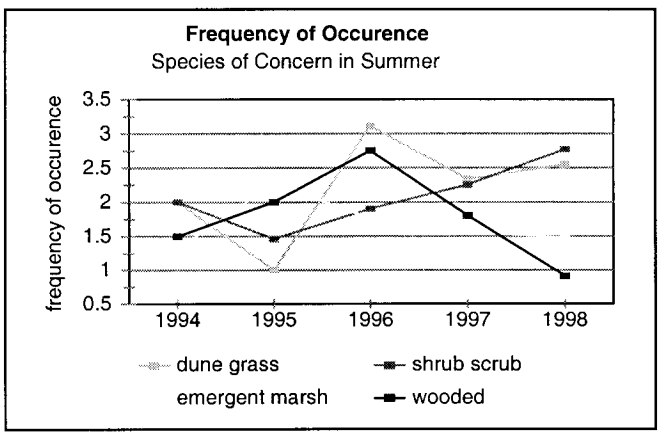

Figure 8: Frequency of occurrence of observed species of concern varies in each habitat during a 5-year summer surveys period.

Bird Species	1994	1995	1996	1997	1998
Rock Dove	0.02	-	0.02	-	-
Mourning Dove	0.04	0.02	-	0.04	0.04
Yellow-billed Cuckoo	0.02	0.04	-	-	0.04
Red-bellied Woodpecker	0.08	0.08	0.17	0.02	0.10
Red-headed Woodpecker	0.02	-	-	-	0.02
Yellow-shafted Flicker	0.02	-	0.02	0.06	0.02
Downy Woodpecker	-	0.04	-	-	0.10
Hairy Woodpecker	-	-	-	-	0.02
Pileated Woodpecker	0.06	0.02	0.02	-	-
Chimney Swift	0.60	0.17	0.10	0.13	0.46
Purple Martin	1.54	0.88	1.13	1.50	3.02
Tree Swallow	-	5.02	0.40	1.35	7.65
N. Rough-winged Swallow	0.25	0.02	-	0.13	-
Barn Swallow	1.58	12.38	2.13	4.35	4.52
Ruby-throated Hummingbird	0.02	-	0.02	-	0.10
Carolina Wren	0.42	0.52	0.25	0.25	0.42
Sedge Wren	-	-	0.02	0.06	-
Marsh Wren	-	0.04	0.10	0.08	0.02
White-breasted Nuthatch	-	-	0.06	0.02	-
Brown-headed Nuthatch	-	-	0.04	-	0.02
Eastern Tufted Titmouse	0.06	-	0.04	0.02	0.04
Carolina Chickadee	0.10	0.21	0.13	0.10	0.38
Ruby-crowned Kinglet	-	0.02	-	-	-
Blue-gray Gnatcatcher	0.08	0.10	0.06	0.25	0.10
Eastern Kingbird	0.29	0.21	0.29	0.38	0.29
Acadian Flycatcher	0.02	0.02	-	0.02	-
Great Crested Flycatcher	0.19	0.10	0.25	0.25	0.31
Eastern Wood Pewee	-	0.02	0.04	-	0.08
Northern Mockingbird	0.21	0.15	0.08	0.15	0.21
Gray Catbird	0.54	0.71	0.15	0.21	0.25
Brown Thrasher	0.23	0.21	0.15	0.25	0.17
Water Pipit	-	-	-	-	0.02
American Robin	0.02	0.04	0.02	0.02	-
Wood Thrush	0.02	0.13	0.06	-	0.04
Blue Jay	0.08	0.10	0.40	0.13	0.08
American Crow	0.83	0.63	0.69	1.38	0.85
Fish Crow	0.29	0.13	0.06	0.06	0.23
Crow sp.	-	-	-	-	-
Cedar Waxwing	-	0.02	-	0.04	0.04
White-eyed Vireo	0.10	0.15	0.13	0.08	0.23
Red-eyed Vireo	0.10	0.13	0.17	0.13	0.06
Northern Parula	-	0.08	0.02	-	0.02
Yellow Warbler	0.06	0.27	0.02	-	0.02
Black-throated Blue Warbler	0.06	0.06	0.02	-	0.04
Black-throated green Warbler	-	0.02	-	-	-
Blackpoll Warbler	0.19	0.15	-	0.06	0.21
Myrtle Warbler	0.25	0.48	0.15	0.35	0.17
Pine Warbler	0.33	0.31	0.17	0.29	0.25
Prairie Warbler	0.31	0.19	0.25	0.35	0.25

Hooded Warbler	0.02	-	0.04	-	-
Prothonotary Warbler	0.17	0.08	0.04	0.06	0.04
Yellow-throated Warbler	-	0.04	-	-	-
Black-and-white Warbler	-	0.04	-	-	-
Blue-winged Warbler	-	0.02	-	-	-
Ovenbird	0.25	0.10	0.08	0.17	0.08
Yellow-breasted Chat	0.19	0.25	0.06	0.17	0.13
Common Yellowthroat	1.38	1.13	1.38	0.98	1.04
American Redstart	-	-	-	0.02	-
Louisiana Waterthrush	-	0.02	-	0.02	-
Eastern Towhee	0.67	0.73	0.69	0.40	0.79
Northern Cardinal	0.44	0.48	0.77	0.50	0.75
Indigo Bunting	-	0.02	0.02	-	0.08
Blue Grosbeak	0.08	0.04	0.04	0.06	0.02
Rose-breasted Grosbeak	-	0.02	-	-	-
House Finch	-	-	0.02	-	-
American Goldfinch	-	0.02	0.15	0.31	0.08
Chipping Sparrow	-	-	-	-	0.02
Field Sparrow	0.40	0.29	0.44	0.27	0.29
Song Sparrow	0.23	0.44	0.06	0.06	0.17
Swamp Sparrow	0.02	-	-	0.02	0.04
Savannah Sparrow	-	0.04	-	0.02	0.04
White-throated Sparrow	-	-	0.10	-	0.02
Sparrow sp.	0.02	0.02	0.04	-	-
Scarlet Tanager	-	0.04	-	-	0.02
Summer Tanager	-	-	-	0.02	0.04
Brown-headed cowbird	0.46	1.44	1.19	0.58	0.50
Red-winged Blackbird	3.48	2.54	6.58	6.90	6.79
Eastern Meadowlark	0.40	0.21	0.65	0.31	0.15
Baltimore Oriole	-	-	-	0.04	0.04
Orchard Oriole	0.04	0.02	0.19	0.13	0.06
Boat-tailed Grackle	2.77	2.15	1.63	1.02	2.52
Common Grackle	1.35	1.27	2.81	1.48	1.04
Grackle sp.	-	-	-	-	-
European Starling	-	0.08	0.27	-	-

Table 7: An average relative abundance of each landbird species were observed on the refuge, regardless of habitats, during a 5-year spring surveys period.

Bird Species	1994	1995	1996	1997	1998
Mourning Dove	0.23	0.13	-	0.06	0.06
Yellow-billed Cuckoo	0.06	0.10	0.17	0.17	0.25
Downy Woodpecker	0.06	0.04	-	0.04	0.10
Chimney Swift	-	0.02	0.04	-	-
Purple Martin	1.04	0.85	0.79	1.88	0.23
Tree Swallow	-	-	0.02	0.04	0.04
Barn Swallow	0.46	0.08	0.17	0.42	0.25
Carolina Wren	0.42	0.46	0.23	0.38	0.56
Eastern Kingbird	0.13	0.10	0.27	0.19	0.19
Great Crested Flycatcher	0.04	0.08	0.06	0.19	0.06
Eastern Wood Pewee	0.04	0.08	-	0.19	0.06
Northern Mockingbird	0.15	0.19	0.17	0.40	0.38
Gray Catbird	0.25	0.17	0.15	0.21	0.15
Brown Thrasher	0.13	0.31	0.13	0.21	0.21
American Robin	0.13	-	-	-	0.06
Blue Jay	0.02	0.04	0.13	0.19	0.06
American Crow	0.83	0.69	0.58	1.21	0.90
Fish Crow	0.23	0.15	0.06	0.08	0.42
Crow sp.	-	-	0.02	-	0.02
White-eyed Vireo	0.04	0.04	0.06	0.08	0.08
Yellow Warbler	-	-	-	-	0.06
Prairie Warbler	-	0.08	0.02	0.17	0.06
Yellow-breasted Chat	0.27	0.19	0.31	0.46	0.38
Common Yellowthroat	0.52	0.79	0.85	0.88	0.63
American Redstart	-	-	0.02	-	-
Eastern Towhee	0.46	0.77	0.69	1.23	0.67
Northern Cardinal	0.42	0.50	0.44	0.94	0.85
Indigo Bunting	0.25	0.29	0.42	0.15	0.35
Blue Grosbeak	0.02	0.04	0.02	0.02	0.08
Rose-breasted Grosbeak	-	-	-	-	-
House Finch	0.96	0.73	0.29	0.02	0.04
American Goldfinch	-	0.13	0.02	0.67	0.04
Field Sparrow	0.23	0.17	0.21	0.52	0.38
Song Sparrow	0.21	0.29	0.15	0.21	0.10
Brown-headed cowbird	0.25	0.54	0.33	0.44	0.19
Red-winged Blackbird	2.08	2.10	3.44	6.27	5.15
Eastern Meadowlark	0.44	0.23	0.25	0.33	0.38
Orchard Oriole	0.06	0.02	0.02	0.17	0.08
Boat-tailed Grackle	3.90	2.42	2.90	4.98	3.02
Common Grackle	0.77	1.10	2.77	1.79	2.13
European Starling	1.21	0.02	-	0.29	6.73

Table 8: An average relative abundance of each landbird species was observed on the refuge, regardless of habitats, during a 5-year summer surveys period.